

ACCESSION #: 9604220194

LICENSEE EVENT REPORT (LER)

FACILITY NAME: Prairie Island Nuclear Generating Plant PAGE: 1 OF 3

Unit 2

DOCKET NUMBER: 05000306

TITLE: Reactor Trip Caused by Failure of Feedwater Regulating

Valve

EVENT DATE: 03/19/96 LER #: 96-01-00 REPORT DATE: 4/18/96

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: N POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:

50.73(a)(2)(v)

LICENSEE CONTACT FOR THIS LER:

NAME: Jack Leveille TELEPHONE: (612) 388-1121

COMPONENT FAILURE DESCRIPTION:

CAUSE: B SYSTEM: SJ COMPONENT: FCV MANUFACTURER: C635

REPORTABLE NPRDS: Yes

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

At approximately 0011 hours on March 19, 1996, while operating at 100 percent reactor power, Unit 2 experienced a reactor trip generated by a protective signal received from Low Low Steam Generator Water Level. Significant observations by Control Room personnel included indication of 100 percent demand signal on CV-31135 and indications of decreasing water level in 21 Steam Generator with no feedwater flow in Loop A. Additionally, a lock-in trouble annunciation for the feedwater control system was received. Also heard and felt by Operations personnel immediately preceding this event

was a loud thud which was probably water hammer.

After the plant was in a stable condition, an investigation was begun and the cause of the trip was determined. CV-31135, Loop A Feedwater Regulating Valve, was isolated and stroked with no externally visible impairment of operation. But because of observed indications and plant response, it was decided to disassemble CV-31135 as it was the most likely candidate to initiate this event. During disassembly of CV-31135 it was observed that the valve plug had separated from the valve stem.

The valve stem/valve plug separation resulted in the valve plug dropping completely into the valve cage obstructing all Loop A feedwater flow to 21 Steam Generator. This ultimately resulted in the loss of the unit on a Low Low Steam Generator Water Level reactor trip.

TEXT PAGE 2 OF 3

TEXT PAGE 2 OF 3

#### EVENT DESCRIPTION

At approximately 0011 hours on March 19, 1996, while operating at 100 percent reactor power, Unit 2 experienced a reactor trip generated by a protective signal received from Low Low Steam Generator Water Level.

Significant observations by Control Room personnel included indication of 100 percent demand signal on CV-31135 and indications of decreasing water level in 21 Steam Generator (EIS Component ID - SG) with no feedwater (EIS System ID - SJ) flow in Loop A. Additionally, a lock-in trouble annunciation for the feedwater control system (EIS System ID - JB) was received. Also heard and felt by Operations personnel immediately preceding this event was a loud thud which was probably water hammer.

The plant response to the reactor trip was as expected.

After the plant was in a stable condition, an investigation was begun and the cause of the trip was determined. CV-31135, Loop A Feedwater Regulating Valve (EIS Component ID - FCV), was isolated and stroked with

no externally visible impairment of operation. But because of observed indications and plant response, it was decided to disassemble CV-31135 as it was the most likely candidate to initiate this event.

#### CAUSE OF THE EVENT

During disassembly of CV-31135 it was observed that the valve plug had separated from the valve stem. Visual examination revealed that the valve stem had fractured leaving a small piece remaining in the valve plug. Examination of the remnant piece suggested a ductile tensile separation with no visual indication of torsional stress. However, the through pin between the valve plug and the valve stem showed obvious torsional shear. The assembly of the valve stem into the valve plug is a threaded connection beneath a taper joint. The valve stem is torqued into the taper joint on assembly, creating a friction interface between the mated surfaces which assists in sustaining the joint. The joint is then cross drilled with a through pin inserted to maintain the friction interface. It is unlikely at this point that any tensile preload is developed in the threaded area. It is known that a large torsional stress is exerted on the valve stem/plug during low power/low flow operations and has been a contributing factor in similar failures. It is surmised, based upon the visual evidence, that this torsional stress created the shear failure in the through pin. The failure of the through pin allowed the valve stem to begin to unthread from the valve plug undermining the friction interface. This condition now exposed the valve

stem to tensile loading and would exacerbate any pre-existing material flaw conditions. This resulted at some point in the ultimate failure of the valve stem with the attendant separation of the valve plug.

Visual examination of CV-31135 indicates that the most likely cause of the component failure appears to be a pre-existing material flaw that when exposed to tensile stress resulted in the fracture of the valve stem. The torsional stress that low power/low flow conditions create provided the opportunity for the

TEXT PAGE 3 OF 3

stem defect(s) to become exposed to the tensile stress which ultimately led to the valve stem/valve plug separation. The valve stem/valve plug separation resulted in the valve plug dropping completely into the valve cage obstructing all Loop A feedwater flow to 21 Steam Generator. This ultimately resulted in the loss of the unit on a Low Low Steam Generator Water Level reactor trip.

#### ANALYSIS OF THE EVENT

This event is reportable pursuant to 10CFR50.73(a)(2)(iv) since this was an unplanned actuation of the reactor protection system. Response of the primary system was as expected. Health and safety of the public were unaffected.

#### CORRECTIVE ACTION

Prior to return to power after rework of CV-31135, CV-31136 (Loop B Feedwater Regulating Valve) was stroked to confirm that the existing

condition matched the original calibration data and that there was no indication of a similar separation on loop B.

It is planned to modify the joint configuration to increase the joint resistance to any applied torsional moment and thereby reduce exposure to similar future failures.

It is planned to review the operating procedures and the digital feedwater control system to determine if it is possible to transit through the period of low flow conditions on reactor startup more expeditiously. This would reduce exposure to the window in which the feedwater control valves are exposed to the large torsional force.

Before any operational changes are considered, however, the valve stem torsional stresses will be measured for varying plant conditions in order to evaluate the need for any operational changes.

#### FAILED COMPONENT IDENTIFICATION

Copes-Vulcan 12 inch, 900 #, air-operated control valve, Model No. D-100

#### PREVIOUS SIMILAR EVENTS

There have been no other similar events reported.

ATTACHMENT 1 TO 9604220194 PAGE 1 OF 1 ATTACHMENT 1 TO 9604220194  
PAGE 1 OF 1

Northern States Power Company

Prairie Island Nuclear Generating Plant

1717 Wakonade Dr. East

Welch, Minnesota 55089

April 18, 1996

10 CFR Part 50

Section 50.73

U S Nuclear Regulatory Commission

Attn: Document Control Desk

Washington, DC 20555

PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Docket Nos. 50-282 License Nos. DPR-42

50-306 DPR-60

Reactor Trip Caused by Failure of Feedwater Regulating Valve

The Licensee Event Report for this occurrence is attached. In the report, we made no new NRC commitments.

This event was reported via the Emergency Notification System in accordance with 10 CFR Part 50, Section 50.72, on March 19, 1996. Please contact us if you require additional information related to this event.

Michael D Wadley

Plant Manager

Prairie Island Nuclear Generating Plant

c: Regional Administrator - Region III, NRC

NRR Project Manager, NRC

Senior Resident Inspector, NRC

Kris Sanda, State of Minnesota

Attachment

\*\*\* END OF DOCUMENT \*\*\*

---